

**FEATURES
SECTION**

Current Products and Practice

Clinical photographs—the gold standard

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Abstract

This survey was carried out to allow a minimum data set required for intra- and extra-oral photographs to be established. In 1999 a questionnaire was sent to members of the Angle Society of Europe to establish their current clinical practice with regard to extra- and intra-oral photography. The Angle Society was chosen because of their stated commitment to a high standard of record keeping and of clinical care.

Results showed that a full series of extra- and intra-oral photographs were taken both before and after treatment, as well as stage photographs during treatment on many cases. The need for each of these photographs will be discussed in some detail, and recommendations will be made as to what would be considered the Gold standard before, during, and after a course of orthodontic treatment.

Index words:

*Clinical photography,
Gold Standard, Angle
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Introduction

It is becoming increasingly important that high quality clinical records are taken as part of a course of orthodontic treatment. Study models tend to be the one record that is consistently taken for orthodontic patients throughout the world. The quality of study models is very variable and unless great care is taken both with the impressions themselves, with the wax registration bite, and with the choice of laboratory, study models can end up offering less clinical information than is ideally required. Clinical photographs, however, can offer at least as much, if not more information provided care is taken when obtaining these photographs.

Clinical Photographic Survey

In order to determine what could be considered the minimum data set for both intra- and extra-oral photographs, we carried out a survey into the use of clinical photography. The Angle Society of Europe was chosen as the body to be approached to seek their opinions on clinical photography because of their commitment to high quality orthodontic records, as well as high quality care. This is a group of orthodontists from 12 European

countries who meet on an annual basis to discuss all aspects of orthodontics. One of their aims is to promote educational standards for adequate training in all aspects of modern orthodontics.¹

A tick box questionnaire was sent out asking a number of questions about current practice. They were asked the following:

- which intra-oral and extra-oral photographs they currently take;
- when during treatment these photographs are taken;
- which staff member takes the photographs;
- what medium is used to record the images.

Results of the study

Seventy questionnaires were sent out and within 6 weeks 68 replies were received, which represents a response rate of 96 per cent.

Routine use of photography

An enquiry was made as to when in a normal course of orthodontic treatment photographs were taken. Ninety-

eight per cent of the responders take photographs pre- and post-treatment for all their patients (Figure 1).

As to the type of extra-oral photographs used, 94 per cent of the responders take a full-face photograph and, in addition to this, 70 per cent take a full-face smiling photograph. The three-quarter view is taken by just under half of the responders. Eighty-seven per cent take a right profile and 32 per cent take a left profile (Figure 2). As far as the intra-oral photographs are concerned, 98 per cent take right buccal, front, and left buccal intra-oral photographs with 70 per cent taking upper and lower occlusal photographs, 90 per cent of these with an occlusal mirror. The overjet photograph was only taken by 4 per cent of the responders and 62 per cent of the responders used buccal mirrors for the buccal shots (Figure 3).

When we considered routine practice for taking photographs during orthodontic treatment, only 20 per cent of the responders stated that they rarely took mid-treatment shots. Thirty-five per cent stated they would take mid-treatment shots in up to a quarter of their patients, another 15 per cent in half of their patients, and almost a third of the responders stated they took mid-treatment shots in more than half of their patients (Figure 4).

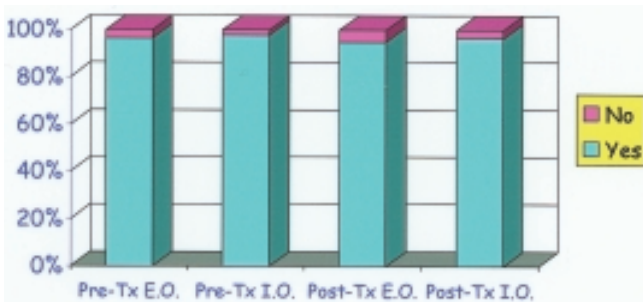


Fig. 1 Routine use of photography.

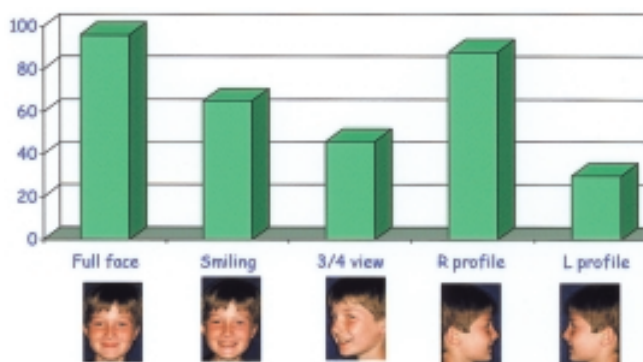


Fig. 2 Extra-oral views taken.

The next question asked was ‘who in the orthodontic team actually takes the photographs?’ Sixty per cent of the time the orthodontists take the photographs themselves, whilst in 35 per cent of the cases one of the ancillary staff would be asked to take the photographs. In 5 per cent of the questionnaires returned, a professional photographer was asked to take the photographs and this would almost certainly be those who work in academic institutions throughout Europe and have easy access to professional clinical photographers (Figure 5).

An enquiry was made as to what particular photographic medium was being used for recording the photographs and, in a vast majority of cases (85 per cent), 35-mm slides were used to record the patient images. In another 7 per cent a mixture of slides and prints were used and in 2 per cent of responders photographic prints were the only medium used for recording patient images. Only 6 per cent of the responders were using digital photographs to record all or some of their patient images (Figure 6).

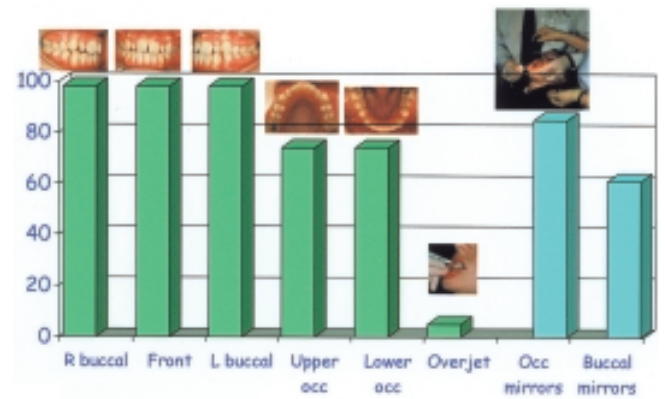


Fig. 3 Intra-oral photographs taken.

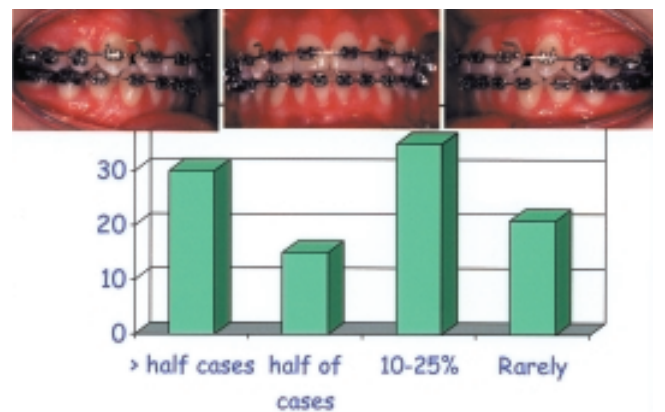


Fig. 4 Mid-treatment shots.

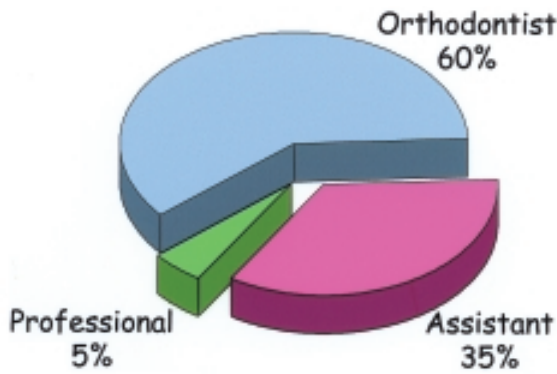


Fig. 5 Who takes the photos?.

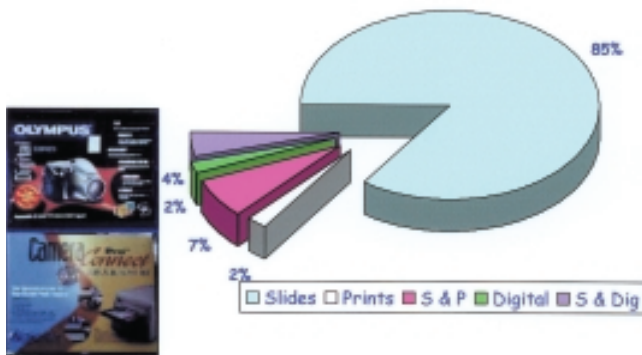


Fig. 6 Photographic media used.

Remuneration for photographs throughout Europe

The orthodontists were asked to estimate what proportion of their total treatment fee could be assigned to the photographs and as one might expect there was a marked variation throughout the European countries. Even within country groups there was sometimes variability of fees for clinical photographs and, therefore, an average fee for each country was assigned.

Fees were recorded in Euros to allow easy comparisons to be made. The lowest fee assignable to photographs was the NHS fee in the UK. The highest fee (Switzerland) was 12 times greater than the lowest (UK). The average fee estimated for orthodontic photography associated with a full course of orthodontic treatment was around 50 Euros (Table 1).

Need for clinical photographs

From the results obtained in the study a minimum data set for orthodontic photography could be constructed.

Table 1 Estimated photography fees (in Euros).

Country	Fees
Switzerland	160
Denmark	150
UK (private)	60
Germany	50
Austria	50
France	35
Belgium	30
Iceland	20
Portugal	20
Spain	15
UK (NHS)	10

These are standard extra-oral views comprising full-face view with lips at rest, full face smiling, a three-quarter view, and a lateral profile view.

Some orthodontic treatment can dramatically affect our patient's appearance. Obviously reduction of large overjets or overbites can greatly enhance a patient's smile, as well as improving the relationship between the soft tissues to the upper and lower lips. The full face smiling view is also important because it is this view that we can perhaps most affect as a result of our ministrations.

During normal social intercourse, however, one tends not to engage people in conversation directly from the front. The view we see of most people tends to be slightly off-centre, closer to a three-quarter view, and this view is, therefore, of particular interest. If a three-quarter view is taken with the patient smiling this can be of great benefit in comparing before and after treatment.

The patient's profile can also change during orthodontic treatment, and it is therefore very helpful to have profile views both before and after treatment. Functional appliances can sometimes have a very rapid affect on profile, perhaps introducing lip competence after only a few months treatment. Repeating extra-oral views after a successful course of functional appliance therapy is therefore often useful.

Intra-oral photographs

The front intra-oral photograph details the appearance of the teeth as seen by the patient, the parent, and the general public. Obviously, it is very important to have a quality photograph of the front intra-oral view. This

documents both the original malocclusion, and also the hard tissue and soft tissue health pre-treatment.

The buccal intra-oral shots serve a very useful function giving details of the malocclusion. The patient should be told to close in centric relation for this photograph. If taken perpendicular to a tangent of the arch in the premolar/molar area it can offer a great deal of information as to the severity of the malocclusion, the need for treatment, the difficulty of any proposed treatment, and how much anchorage is required.

The upper and lower occlusal views can be used in assessing the space requirement in any particular case. In the absence of study models the photographs can be used to carry out a detailed and accurate space analysis.² This will allow determination of whether extractions will be required or whether anchorage reinforcement techniques might be necessary.

For high quality occlusal photographs, showing a true plan view of the arch, occlusal mirrors must be used. As seen in the study, the vast majority of responders use occlusal mirrors routinely. One thing that was surprising was that buccal mirrors were used in 60 per cent of cases. In the view of the authors, buccal mirrors fail to offer any significant advantage if the correct retractors have been chosen and are used effectively. The recommendation for the use of retractors and mirrors has been outlined in some detail in a paper by Sandler and Murray.³ Another view that is very occasionally taken is the overjet view. However, this does not really offer any advantages over properly taken intra-oral views.

Discussion

There is a stark contrast between the fact that a full series of both pre- and post-operative photographs are taken almost routinely by the group surveyed, and the situation in the UK, where in the majority of cases only 'three pre treatment photographs are *de rigueur*.

The questionnaire also asked for views on taking photographs mid-treatment. Obviously, there is an advantage to having a photographic record of each arch wire that

was used. This allows an assessment of the progress achieved to that point and often from a teaching point of view, advantages, or disadvantages of any particular approach can be highlighted on these intra-oral photographs. They are also an invaluable record of the patient's level of oral hygiene throughout treatment if the case ever comes to any form of litigation.

Nine pre-treatment and nine post-treatment images should be considered an absolute minimum for each and every orthodontic patient. In addition to this, any patient who undergoes a comprehensive course of treatment with fixed appliances, photographic details of the appliances at each arch wire change, and at any other important stage would be considered the gold standard. It is envisaged that up to 36 photographs per patient are considered a reasonable number to allow full photographic documentation of the average case. If care is used during recording of images a great deal of information about the case is provided, which will prove to be an invaluable record for patient information, teaching purposes, and in the unlikely case of litigation.

Summary

The need for intra- and extra-oral photographs has been discussed, and the case made for a minimum data set of 18 photographs for each and every orthodontic patient. In addition to this, in treatment photographs at each milestone would be considered a necessity and in the future will become routine.

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Teaching and learning: an update for the orthodontist

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Abstract

Index words:

Orthodontics, teaching, active learning

Developments in teaching and learning have implications for every orthodontist. This paper describes some of the theories of teaching and learning that have led to a quiet revolution in higher education. Developments have included the incorporation of self-directed and problem-based learning concepts, together with a more active and interactive role for the learner. The importance of these changes for orthodontic education is discussed.

Introduction

Traditionally medical and dental education has been delivered by a combination of didactic teaching and an apprenticeship to learn clinical skills. Dental students were required to memorize facts and demonstrate skills to reach an acceptable standard at terminal assessment. This style of teaching encouraged the learner to adopt a surface approach to learning where memorization was more important than understanding. The emphasis was on curriculum coverage and not on ensuring students had the skills needed for life-long learning and continuous professional development.^{1,2}

Active learning, in contrast, is a process of engaging with the learning task at both the cognitive and the affective level, in an attempt to foster and develop learning skills for life. The emphasis in teaching style moves away from didactic lectures to small group, student-led interactive teaching. Central to adult learning is the notion of personal motivation, and one of the core skills of teaching is the ability to maintain, develop, and utilize this personal motivation.³ Much of current teaching practice is supported and encouraged by these ideas and the introduction of active learning in dental education requires an evolution, rather than a revolution. The aim of this paper is to provide an update on theories of teaching and learning.

How do we learn?

Learning has been defined as a relatively permanent change in behaviour of the learner.³ This can be demonstrated when students are able to show that they have

gained insight, realization, facts, or new skills.⁴ There are a number of theories on how we learn and we will give a brief résumé of these:

- Constructivism
- Andragogy
- Zone of proximal development
- Learning cycle
- Reflective learning
- Learning styles
- Observational learning

Constructivism

Constructivism is a philosophy founded on the premise that by reflecting on our experiences we construct an understanding of the way our world works. A new experience or fact must be put in the context of that understanding; hence, our bewilderment when something challenges our construct:

Well I never knew that!

According to constructivism students must build on their prior learning and development occurs through problem-solving experiences shared with someone else, usually a teacher, but sometimes a peer. Constructivism also tells us that we learn by fitting in new understanding and knowledge by extending or supplanting old understanding and knowledge. Without changes or additions to pre-existing knowledge and understanding no learning will have occurred.⁵

Ideas about student learning including 'experiential learning' and the use of 'reflection' are based in con-

structivism. Since students learn through interaction, curricula should be designed to emphasize interaction between students and the learning task.

Andragogy

Knowles⁶ developed the concept of andragogy 'the art and science of helping adults learn'. Andragogy is considered to have five principles:

- As a person matures they become more self-directed.
- Adults have accumulated experiences that can be a rich resource for learning.
- Adults become ready to learn when they experience a need to know something.
- Adults tend to be less subject-centred than children; they are increasingly problem-centred.
- For adults the most potent motivators are internal.

In the andragogical perspective the adult learner is self-directed and needs an active learning environment. Hence, the teacher is viewed as a facilitator of the teaching and learning process, and less as the sole source of information. A facilitator should act as a guide, but must ensure that the aims and objectives of the learning task are met.

These concepts are not without their critics who question the need for more longitudinal research to understand how periods of self-direction alternate with more traditional forms of educational participation in adults' autobiographies as learners.⁷

Zone of proximal development

This was introduced by Vygotsky.⁸ The theory describes a student's ability to perform a task in the presence of the teacher that would not have been possible alone. As the student gains in confidence, experience, or knowledge, the teacher becomes more passive and eventually can withdraw. Vygotsky believed that what a student can do with teacher support today, he/she will be able to do alone tomorrow and he defines intelligence as the capacity to learn through instruction. This appears to accord with the old surgical adage of 'see one, do one, teach one'. The zone of proximal development will, however, vary between individuals so teaching and learning environments need to provide a range of activities to allow students to influence their own learning. Students should be able to go at their own pace, within defined limits. Changes in the zone of proximal development can be seen during students' progress through a

postgraduate orthodontic programme. They change from being inexperienced and needing significant teacher support to being independent specialists at the completion of the programme.

Learning cycle

Using ideas from Piaget⁹ and Bruner,¹⁰ Kolb built on the constructivist theory to develop the idea of 'experiential learning'. He believed ideas were not fixed but are formed and re-formed through 'experience'. Kolb represented this idea as the Kolb learning cycle¹¹ (Figure 1). He believed that our experiences are followed by a period of reflection, which leads to the formation of abstract ideas or concepts to solve our problems. This leads us to test our hypothesis with the result that new experiences are assimilated. This continuous process means educators need to focus on imparting learning skills, rather than facts.

Chairside teaching of orthodontics to postgraduate students is a good example of the learning cycle. The patient presents as a clinical problem, and the students are encouraged to use their knowledge of orthodontics to reflect on the problem and then suggest appropriate action. The teacher should provide a 'safe' environment for both patient and student.

Reflective learning

Schon¹² suggested students should become more adept at observing and learning through reflection on the artistry of their own profession. Reflection on practice between the student and teacher should occur. This has implications for learning through clinical practice, as there can be conflicts between clinical and educational needs. The students need a safe environment to apply knowledge in orthodontics and discuss the merits of alternative options, but the patient also needs to make satisfactory progress through treatment and feel they are in 'safe hands'. It is important, therefore, to provide time for reflection where teachers' and students' interaction is not influenced by the presence of patients or parents.

Learning styles

Honey and Mumford¹³ described learning styles in a four-fold classification: activist, reflector, theorist, and pragmatist. Gaining an understanding of learning styles will help both students and teachers to accumulate

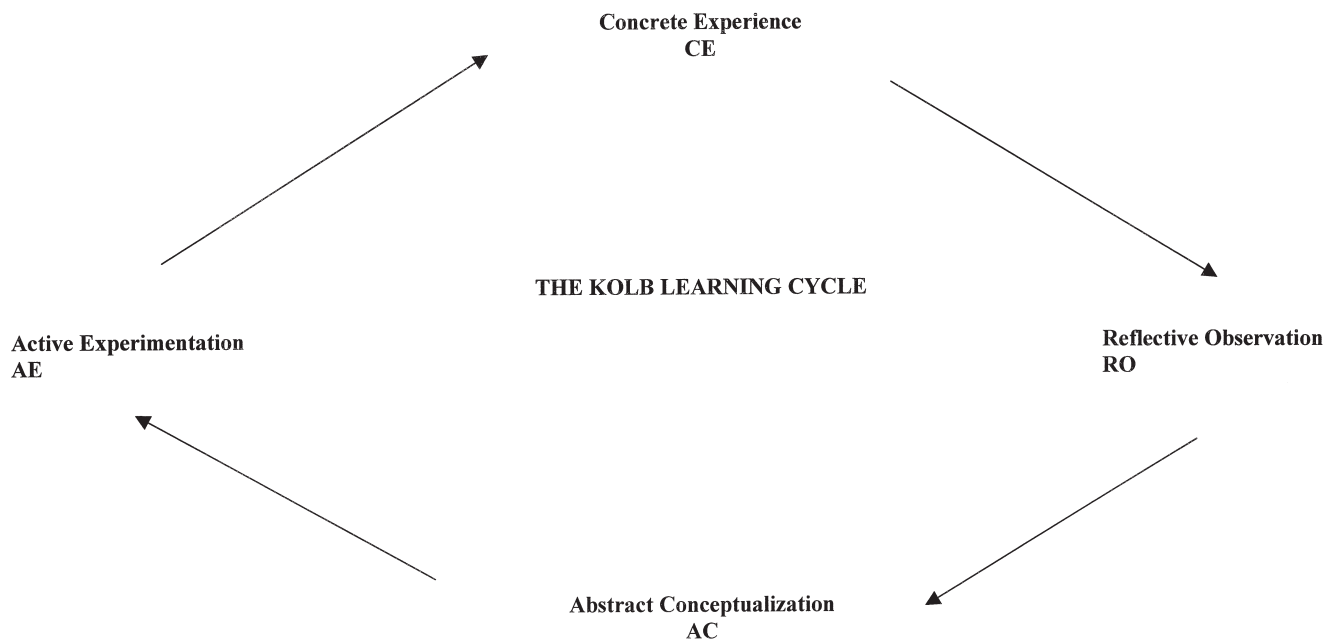


Fig. 1 Caption to come.

knowledge more efficiently. They are a description of the attitudes and behaviours that determine a preferred way of learning for an individual:

- Activists respond most positively to learning situations offering challenge, to include new experiences and problems, excitement, and freedom in their learning.
- Reflectors respond most positively to structured learning activities, where they are provided with time to observe, reflect, and think, and allowed to work in a detailed manner.
- Theorists respond well to logical rational structure and clear aims, where they are given time for methodical exploration and opportunities to question and stretch their intellect.
- Pragmatists respond most positively to practically based immediately relevant learning activities, which allow scope for practice and using theory.

Observational learning

Also called the social learning theory, observational learning occurs when an observer's behaviour changes after viewing the behaviour of a model. The observer will imitate the model's behaviour if the model possesses characteristics that the observer finds attractive or desirable, and the behaviour change is more likely if the model is rewarded in some way. Learning by observa-

tion involves four separate processes: attention, retention, production, and motivation.¹⁴ The implication for trainers in orthodontics is that their behaviour will have a highly significant influence on their trainees. This can be seen on clinic where, years later, we repeat 'phrases' used by our teachers.

How do we teach?

Kember¹⁵ synthesized a body of research to suggest two broad orientations of university teacher (Table 1). These two groups were teacher-centred/content-orientated and student-centred/learning-orientated. Ramsden² simplified these conceptions as:

- teaching as telling or transmission;
- teaching as organizing student activity;
- teaching as making learning possible.

Teaching as telling

The traditional didactic lecture is a representation of this perspective on teaching, where the teacher has the knowledge and the students are passive recipients of knowledge from the speaker. The focus is on the speaker who must be an 'expert' in the field in question and may take pride in the charismatic nature of his/her delivery. Lecturers who use this theory will attribute failure to learn as faults in the students as they conceptualize the

Table 1 Conceptions.

Dimensions	Imparting information	Transmitting structured knowledge	Student-teacher interaction	Facilitating understanding	Conceptual change
Teacher	Presenter	Presenter	Presenter and tutor	Facilitator	Change agent/developer
Teaching	Transfer of information	Transfer of well-structured information	Interactive process	Process of helping students to learn	Development of person and conceptions
Student	Passive recipient	Recipient	Participant	Lecturer responsible for students' learning	Lecturer responsible for student development
Content	Defined by curriculum	Lecturer needs to order and structure material	Defined by teacher	Constructed by students within teacher's framework	Constructed by students but conceptions can be changed
Knowledge	Possessed by lecturer	Possessed by lecturer	Discovered by students, but within lecturers framework	Constructed by students	Socially constructed

D. Kember 1997.

relationship between what the teacher does and what the student learns as an intrinsically unproblematic one.²

Didactic teaching may have a role to play for large groups of learners, for revision of material, or presenting something new. Didactic teaching style can also be appropriate for comparing and contrasting different points of view or linking new material from a number of different sources.³

Teaching as organizing student activity

In this model teaching is no longer seen as transmission, but it is also about dealing with students activity to improve learning. The focus is still on the lecturer and their teaching techniques, and implies that improvement in the teaching technique would improve the learning outcome for the student. Sadly this is not always the case.

Teaching as making learning possible

In this model teaching is comprehended as a process of working cooperatively with learners to help them change their understanding. Teaching here involves finding out about student misunderstandings, intervening to change them, and creating a context of learning, which encourages the student to engage in application of new knowledge. Learning is a process of applying and changing the students' own ideas, it is something the student does, rather than something that is done to the student.²

Problem-based learning

In problem-based learning (PBL) the students are faced as a group with a problem, usually of a clinical nature. The group must identify the relevant learning objectives

cued from the problem and then find the information needed to address these. The gaining of knowledge is more important than 'solving' the problem. The teacher is present as facilitator and must not supply the answers as would be the case in a traditional seminar. The role of the 'teacher' in PBL is much more difficult as they must guide the learners to ensure the learning objectives are met, but must not organize the learning, as this must come from the students themselves. In this form of teaching, the lecturer loses their traditional role as the source of all knowledge. If the group are functioning effectively it may seem that the facilitator is 'not doing anything'.

Functions of teachers

Squires¹⁶ has identified 10 functions that teachers can do for learners that they may find difficult to do for themselves (Table 2). Teachers on didactic programmes must have good subject knowledge and be effective communicators. As active learning is introduced a range of new skills and understanding are required, in addition to this expertise as the teacher must also be able to encourage the learning process.

How should we teach orthodontics?

The primary implication for teaching and learning in orthodontics is the development of active involvement for the learner. Encouraging students to find information for themselves, share this with the group, and reflect on the information that can be used to solve a problem is most likely to require deep level processing and thinking, and hence lead to knowledge that is retained in the long term.⁴

Table 2 Functions of teaching.

Motivate:	Stimulate, get and keep attention, arouse interest, enthuse.
Audit:	Assess needs, identify baseline knowledge and skills, explore initial perceptions and expectations.
Orientate:	Guide, map out, give a sense of direction, set objectives.
Inform:	Transmit, impart, input, put across, tell, show, demonstrate, enact.
Explain:	Go through, go over, interpret, clarify, relate, amplify.
Explore:	Open up, respond, engage in dialogue, brainstorm, discuss, debate.
Develop:	Encourage problem-solving, critical thinking, learning to learn.
Exercise:	Rehearse, set tasks, practise, engage, try out, carry out, experiment, activate.
Appraise:	Feed back, comment, criticize, react, assess, de-brief, act as a sounding board.
Reinforce:	Emphasize, underline, reward, encourage, praise, value.

The implication of adopting active learning on an undergraduate orthodontic programme will vary between schools. Some schools have enthusiastically adopted PBL, yet it is ironic that a profession that demands adherence to scientific method swung so strongly in favour of PBL, despite evidence that the difference in learning outcomes in its favour were small indeed.¹⁷ Norman¹⁸ suggested graduates of PBL schools appear to have a comparable or slightly inferior knowledge base, but are primarily distinguished from their peers on didactic programmes as having a less jaundiced view of the undergraduate experience. Chadwick² has described the adoption of active learning on an undergraduate orthodontic programme through a variety of teaching techniques, including problem-based learning, computer assisted learning (CAL), chair side clinical teaching, and a work book for students to complete at their own pace.

The theories of teaching and learning support some of the present teaching activity in postgraduate orthodontic education. Postgraduate students should build on their prior knowledge of orthodontics, but at the start of the programme they will need intensive support on clinic. Didactic teaching techniques can be useful to provide a framework on which postgraduate students should be encouraged to develop their own ideas. Short diagnostic tests using clinical records that students examine for a limited time and then must present to the group together with proposals for treatment is supported by theories of teaching and learning as are student led seminars. Orthodontic programmes will

vary in their proportion of active, interactive, and didactic teaching and learning opportunities.

If the aim of active learning is to change learner behaviour and equip students with skills needed for life-long learning then adjustments to the teaching on orthodontic postgraduate programmes will not be enough on their own. It is a challenge to the specialty to adapt assessment strategies to ensure cognitive knowledge and clinical skills are tested, but the wider aspirations of student learning are not forgotten.¹⁹ Traditional assessments that have been found in many professional examinations, do little to encourage the range of behaviours and skills developed through active learning, which is unfortunate as learner behaviour is often driven by assessment.

Who should teach orthodontics?

It is clear from the discussion of teaching and learning presented above that being a subject expert does not automatically make that expert a good teacher. Without an understanding of the way adults learn and the concepts of teaching theory the expert will simply repeat the teaching process that they underwent themselves. This is particularly apparent in medical and dental education, where the didactic lecture with clinical slides is the standard format for much of the teaching given to both undergraduate and postgraduate students.

Help to equip specialists for a teaching role is available from a variety of sources. These range from university-based programmes for lecturers to higher education courses leading to a certificate or diploma to short courses such as the Training the Trainers course at the Royal College of Surgeons of England.³ In the same way as we would not consider a weekend course adequate to train an orthodontist, short courses, although a good starting point, cannot alone create a good teacher. The Training the Trainers course is a distillation of the teaching and learning theories outlined above, and these have been used to provide practical advice for the teacher to improve their own teaching style, but an understanding of learning and the importance of reflective practice take time to develop. Opportunities exist to undertake courses leading to certificates or diplomas, and membership of the Institute for Teaching and Learning (ILT). These enable the teacher to explore and reflect on teaching and learning theory, and how it should impact on course design and delivery. Reflective practice is crucial for the teacher to be able to recognize the strengths and weaknesses of the students' learning experience. These prin-

ciples are equally important if orthodontic auxiliaries, undergraduate, and postgraduate students are to have appropriate learning environments.

Conclusions

- Theories of teaching and learning should impact on the design and delivery of orthodontic courses at all levels.
- Active learning is a model that can be successfully adopted on orthodontic courses.
- Teachers on orthodontic courses should have an understanding of the learning process.

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